



Request for Proposals for Pooled Fund Project

Exploring Data Fusion Techniques to Derive Bicycle Volumes on a Network

<http://nitc.trec.pdx.edu/>

1 Overview

The **National Institute for Transportation and Communities** (NITC) is a program of the [Transportation Research and Education Center](#) (TREC) at Portland State University. NITC is the U.S. Department of Transportation's national center for livable communities and one of the U.S. DOT's national university transportation centers.

NITC is a Portland State-led partnership with the Oregon Institute of Technology, University of Arizona, University of Oregon, University of Texas at Arlington, and University of Utah.

Improving the
mobility of people
and goods
to build strong
communities



NITC's pooled-fund grant program is intended to help maximize implementation of U.S. DOT's commitment to improving the mobility of people and goods while providing regional and local agencies, such as metropolitan planning organizations, transit agencies, and municipalities, more opportunity to be invested in research. Research statements were solicited from partner agencies, and the following research need was selected by the NITC Executive Committee to move forward for funding.

1.1 Project Outline

Active transport modes such as bicycling are associated with many advantages including lower congestion and emission levels and improvement in personal health. Many cities are interested in increasing bicycle activity to take advantage of these benefits. To understand if their municipal efforts are successful in increasing bicycle activity, cities require accurate accounting of bicycle traffic.

While historically bicycle volume data have been scarce, many cities and other jurisdictions have been taking steps to set up systematic monitoring, data collection, and archival processes. As a result, bicycle traffic counts are available from a variety of sources, such as manual counts, short duration counts, continuous counts, crowdsourced data (e.g., strava, ride report), bike share flows, surveys, and models. Since directly observing counts are expensive, these data continue to be limited to a few points on the network. As a result, data fusion from various sources has to occur to achieve network coverage for bicycle counts.

Current work on data fusion techniques is limited and additional research is needed to fully understand the choice of weighting techniques, inclusion of spatial vs. temporal variation in the weighting scheme and exploring other model forms. This research intends to fill this gap by 1) exploring data fusion techniques to

determine bicycle volumes on a network using a variety of data sources, 2) exploring which data sources lead to the best results, and 3) determining the accuracy of the various techniques.

NITC and our partners are issuing a Request for Proposals for qualified research teams to respond to this need. The project budget is \$200,000 with research completed within a time period of 18 months.

Proposals are due September 30, 2018 and must be submitted by logging into NITC's online system at: <https://ppms.trec.pdx.edu>. Please select grant cycle "NITC Pooled Fund Round 3".

1.2 Project Partners

This national study brings together cities and local jurisdictions in providing financial support for the project. These include:

- Oregon DOT
- Virginia DOT
- Colorado DOT
- Washington D.C. DOT
- Utah DOT
- Central Lane MPO
- City of Portland, OR
- City of Bend, OR

A subset of these partners will serve on the project Technical Advisory Committee (TAC). The TAC will provide project insight and feedback and will be responsible for reviewing any products, deliverables, and reports produced during the project.

1.3 Eligibility

Faculty members and research faculty eligible to serve as Principal Investigators (PIs) at Portland State University, the University of Oregon, the Oregon Institute of Technology, the University of Arizona, the University of Texas at Arlington, or the University of Utah may submit proposals.

Proposals may include multiple investigators, and collaborative projects across disciplinary and campus boundaries are encouraged. Proposals including multiple investigators must identify one lead PI contact responsible for reporting and associated administrative tasks. NITC Executive Committee members are allowed to submit proposals and are not participating in the selection process for this RFP.

2 Project Tasks

There are multiple objectives of this research with more detail of intended work described in the tasks below. These objectives include:

- (1) Explore data fusion techniques to determine bicycle volumes on a network using third-party data sources and other commonly available data sources.
- (2) Determine which data sources and techniques produce the most usable results while also considering the level of difficulty to implement the technique.
- (3) Create and apply a framework to evaluate the accuracy, coverage, completeness, and representativeness of third-party data.
- (4) Develop a tool for research implementation that makes findings from this work more easily realized.

To achieve these objectives, we expect this research will include the tasks outlined below. These tasks are intended to provide a logical approach, but we are open to suggestions from proposers on how to best accomplish the research objectives with the available funds and time constraints. Proposals should be written in sufficient detail to demonstrate the PI's understanding of the issues and the soundness of approach to meeting the research objectives.

An important objective of this project is to facilitate future research and to ensure the broad application of its findings. As a result, PIs are asked to use open source software and platforms to create scripts and tools to ensure that any interested party will be able to access and use the products of the project. Ideal analysis scripts include, but are not limited to R, Python and QGIS. Data processing, analysis, and visualization code should be well documented and supplied to an open repository such as GitHub, where interested parties can access it easily. This effort will help address a lingering issue whereby existing third party data vendors provide products without fully documenting how products are developed.

For each task, please indicate the deliverable that will be provided to the TAC for review and comment (if appropriate). Tasks may include:

Task 1: Literature Review

Perform a literature review to examine commonly used methods for bicycle volume estimation, and methods for data fusion. The literature review should also include past research and documented descriptions of potential methods used in estimating travel activity for other modes like passenger and freight movements. Lastly, the review should cover past approaches to assess third party data quality. This review will be provided to the TAC in a summary memo for review.

Task 2: Identify and Catalogue Study Locations

Explore candidate sites where empirical counts data and third-party data (e.g. Strava, Ride Report, Map My Ride, Moves and bike share) are available for analysis. Datasets of particular interest include count data and GPS data such as self-reported trips from smart phone apps. Options exist for how data gathering might proceed, with possible collaboration from data vendors. Research teams can anticipate one of two tracks for acquiring third-party data. The first option is to work with public agencies that have purchased these data and attain copies for use in this project. Many of the pooled fund participants have purchased data and have committed to participating in this process. The second option would involve a separate data purchase, using a very limited amount of the pooled funds, for data needed for this project. The results of this task will be summarized and provided to the TAC in a summary memo for review.

Task 3: Data Gathering

Gather all available data sources at the identified locations where third-party data and empirical counts data coincide. Count data can include short and long term counts. Third-party data sets should be collected and processed in a way to make them usable for comparison with counts data. Other data sources most likely necessary for this project include bicycle network data as well as population and employment data. Past research has found that network accessibility and measures of centrality are relevant predictors of non-motorized traffic volumes so network data is likely a key resource for this work and will need to be compiled. The results of this task will be summarized and provided to the TAC in a summary memo for review.

Optional: Develop tools for calculating bicycle accessibility and centrality using easily acquired data like Open Streets Map. These measures are likely important elements for inclusion in the data fusion models.

Task 4: Develop Data Fusion Models

Initial model development will include analysis of the longitudinal consistency of third party data to understand how market share is changing. For instance, usage may appear to change on a given facility only because a given third party data product usage is changing but actual facility usage is unchanged or changing in the opposite direction.

Next, the research team will develop models using available data sources to predict observed bicycle traffic counts. Test different model forms to determine the best predictive performance and understand the benefits of additional but perhaps less commonly available data sets. Common validation techniques should be used to verify model performance like Monte Carlo hold out or k-fold cross-validation. Centrality measures would require a routable network but may not be available for many agencies but it could improve model performance. A key deliverable for this task is demonstrating the trade-offs on model accuracy for certain inputs like the availability of count data and more complicated measures derived from network data. The results of this task will be summarized and provided to the TAC in a summary memo for review.

Task 5: Model Application

Using models developed in Task 4, apply models to appropriate study areas. Compare the results across geographies to understand limitations and opportunities in applied models. Consider the results in comparison to other available data sets such as travel model estimates, travel surveys, Census Journey to Work, crash data, etc., to better understand the overall performance of the models. The results of this task will be summarized and provided to the TAC in a summary memo for review.

Optional: Apply the models in high level crash rate calculations for select states and urban areas.

Task 6: Prepare the final report.

Prepare a final report that documents the details of the tasks described above in a synthesis of previous summary memos. The documentation of the final data fusion models should be detailed enough to allow others to easily understand the underlying processes. The report should also include recommendations to support research objectives including:

- Outline the appropriate data fusion techniques given specific data sources and their accuracy.
- Identify data sources that are most suitable to use for techniques.
- Provide clear guidance on how to set up future bicycle count programs given documented third-party data coverage and outline additional parameters that may need to be considered when setting up bicycle count programs.

The report will be crafted throughout the process with summary memos following completion of each task. Each memo will be reviewed by the TAC with comments and questions submitted to the research team for consideration.

Task 7: Make Project Data Processing and Analysis Scripts Available

Make data processing, analysis, and visualization code with detailed documentation available on an open repository such as GitHub, where interested parties can easily access it. All or a portion of the scripts may also need to be shared on NITC's open access repository, PDXScholar, for long-term storage. This research needs to be transparent and open for anyone interested in understanding the details and underlying process.

Note: Proposers should include (a) quarterly conference calls with the TAC, (b) deliverables for each task (as appropriate), and (c) at least one in-person meeting with the project panel. Proposers should also discuss how they intend to communicate and work with the TAC throughout the project. Proposers should plan that NITC and the project panel will require no less than 2 weeks for review before the meeting occurs. For budgeting purposes, proposers should plan for at least one in-person meeting with the TAC to coincide with a national conference or meeting that the majority of the TAC can be present. Travel costs should be included in the budget.

Please reach out to NITC's Research Program Administrator, Eva-Maria Muecke, emuecke@pdx.edu, if you have questions about the scope and/or tasks of the project.

3 Project Requirements

PIs will be asked to provide progress reports and performance metrics related to their funded research for federal reporting. Additional reporting requirements may also be required to match partners. Adequate progress and performance on previously funded research is an overriding consideration for the funding of future grants, including this RFP. Those that have not submitted progress reports or final reports will not be considered for funding and risk having funds withheld from current grants. Similar restrictions will apply to any future NITC funding opportunities.

3.1 Progress Reports

Semiannual progress reports are required according to NITC's funding requirements. These reports will support NITC's federal reporting responsibilities. Reports will be submitted on-line and include: accomplishments, dissemination activities, products (e.g. submitted publications, conference presentations, websites, etc.), detailed information on project participants, including faculty, students, and partners, impact of the project, and changes/problems. As part of the final progress report, we will also require information regarding undergraduate and graduate students participating in the research, and information relating to publications and presentations presented at academic/professional meetings resulting from the funded research. Additional progress reports to match partners may also be required.

3.2 Publications and Presentations

PIs and students who are funded by NITC will be expected to prepare articles based on research findings for publication in refereed journals and make presentations at national conferences. Through these venues, researchers and students will receive additional peer-review feedback on their work and should incorporate this into their projects. Electronic copies of all papers submitted to journals or conferences that are based on the project research should be provided to NITC. NITC support has to be acknowledged in all work that results from NITC funding. Student contributions to research should be acknowledged in publications via acknowledgement, footnote or co-authorship. Travel funds in the amount of \$3000 will be provided by NITC for sharing and presenting results at conferences or similar opportunities.

3.3 Final Report/Products

PIs shall produce a final report that will be reviewed by the TAC. For proposals for this RFP, PIs should plan on submitting a draft final report conforming to style guidelines (templates will be available on the web) by **May 30, 2020**. The report should document the research project in total, including a complete description of the problem, objectives, approach, methodology, findings, conclusions, and recommendations. The final report should document all data gathered, analyses performed, and results achieved.

PIs are responsible for incorporating peer-review comments into the final report. Before publishing, final reports that incorporate comments will be reviewed by an editor to ensure standard formatting requirements are met. When a report is produced as part of a joint effort, NITC will work with the matching/sponsoring entity to ensure that one report will meet the requirements of all partners. All final reports will be produced as part of a numbered report series, and will include the USDOT disclaimer and NITC and partner funding attribution. All final reports will be posted on-line. More details about project requirements can be found in the "*Principal Investigator's Guide to Sponsored Activities*" posted online.

3.4 Budget

NITC plans to award up to \$200,000 for this project.

Applicants must use the NITC Budget Form. Proposal budgets should be conservative and cost-effective, and should be primarily directed at new and original work. Funds should be spent in a manner that provides publishable results, especially in refereed journals. In general, faculty salary (summer or academic year), student support, and tuition/fee reimbursement are allowable expenses. A limited amount of travel for data collection purposes and materials and supplies may be included, provided that they are a direct expense related to completing the work. PIs can also budget travel for the in-person meeting with the TAC.

Funding for students is expected, such as research assistant tuition and salary. Federal indirect costs (overhead) specific to each NITC university and OPE (fringe benefits) should also be included in the budget. *Tuition charges are not subject to indirect costs.* Equipment purchases (equipment is generally defined as items over \$5,000) and international travel are not permitted unless specific justification is provided and *prior* approval is obtained from NITC and the U.S. DOT. Budget for expenses normally considered part of university F&A (phones, facilities, regular office supplies, computers, etc.) should not be included.

Funding for salary that goes beyond normal academic or summer compensation will not be allowed. In the case of joint projects with faculty from other NITC universities, the second university activity should be budgeted as a separate budget for that university. In addition:

- Projects should be budgeted to begin on or after **December 1, 2018** and completed by **June 30, 2020**. Please plan to submit the draft final report by **May 30, 2020**.
- New awards to prior investigators will depend on successful completion of previously-funded projects and timeliness of research progress and reporting.
- NITC reserves the right to request reductions or other changes to budgets of submitted proposals. Budgets should be conservative and cost-effective, and should follow all budget guidelines for indirect cost rates, allowable expenditures, etc.
- Awards are cost-reimbursable.

3.5 Matching Funds

Matching funds are provided by the project partners. Should the budget exceed \$200,000, the proposer will be expected to find additional cash match for funds requested from NITC.

3.6 Evaluation Criteria

All proposals will be reviewed by a TAC consisting of a subset of the partner agencies. The TAC will evaluate and rank the proposals using the criteria below and will convene to discuss the merits of each proposal:

- (1) the proposer's demonstrated understanding of the problem;
- (2) the merit of the proposed research approach and methodology; and
- (3) experience and qualifications of the proposers.

4 How to Apply

4.1.1 Project Proposals and Budgets

Proposals are due October 01, 2018 at 5:00 PM PDT. Complete the Proposal Form (Word document) and Budget Form (Excel spreadsheet) and submit on-line (<https://ppms.trec.pdx.edu>). Proposals are typically 10 to 12 pages long. Please do not use prior year forms.

Proposals and budgets must be approved by the PI's home university research office prior to submission and **will not be considered without their approval**. PIs must follow their university's requirements for approval of proposals, including match commitment and use of human subjects (if applicable). Further questions regarding university approval should be directed to the home university research administration office or the home university Executive Committee member:

- **Oregon Tech:** Office of Strategic Partnerships: <http://www.oit.edu/faculty-staff/sponsored-projects-grants-administration>
Preliminary approval form: <http://www.oit.edu/docs/default-source/spa/proposal-approval-form.pdf?sfvrsn=4>
- **PSU:** Proposal Internal Approval Form (PIAF):
<https://sites.google.com/a/pdx.edu/research/lifecycle/proposal/psu-proposal-approval>
Note that an additional NITC-specific form will also be required and sent to PIs after they submit their projects abstracts.
- **UO:** Apply through Electronic Proposal Clearance System (E-PCS) and Office of Research Services and Administration: <http://orsa.uoregon.edu/>
- **UA:** Research, Discovery & Innovation: <http://research.arizona.edu/>
- **UTA:** Research Administration: <http://www.uta.edu/uta/research.php>
- **UU:** UU Office of Sponsored Project: <http://www.osp.utah.edu/>

5 Contact Information

For questions about this RFP, please contact Eva-Maria Muecke, Research Program Administrator, 503-725-2897, emuecke@pdx.edu. Each campus has a representative on NITC's Executive Committee who can discuss the process:

- Marc Schlossberg, University of Oregon, 541-346-2046, schlossb@uoregon.edu
- Keith Bartholomew, University of Utah, 801-585-8944, bartholomew@arch.utah.edu
- Roger Lindgren, Oregon Institute of Technology, 541-885-1947, roger.lindgren@oit.edu
- Avinash Unnikrishnan, Portland State University, 503-725-2872, uavinash@pdx.edu
- Arlie Adkins, University of Arizona, 503-880-3110, arlieadkins@email.arizona.edu
- Stephen Mattingly, University of Texas, Arlington, 817-272-2859, mattingly@uta.edu

For other questions, please contact Hau Hagedorn, TREC Interim Director, 503-725-2833, hagedorn@pdx.edu.

